



Building a Model Aquifer

BACKGROUND:

Although nearly half of all Americans get their drinking water from wells, many people have never heard of ground water. Use of ground water supplies is increasing at twice the rate of surface supplies, and the trend is expected to continue. Until the late 1970's, it was widely believed that ground water was protected from contamination by the natural filtering effect of the many layers of soil, sand, gravel and rocks. We now know that pollutants can travel through all these layers. Incidents of serious contamination have been reported in every state in the nation

OBJECTIVE:

The student will use a model of an aquifer to describe how ground water flows through an aquifer, how ground water can become contaminated, and why it is so difficult to clean contaminated ground water.

TEACHER SUGGESTIONS:

This model can be a very flexible tool which will allow students to simply study groundwater flow, look at how well placement affects yield, or examine how ground water is vulnerable to contamination.

Depending on the resources, the teacher may lead groups of four or five students in building their own models as described below, or the teacher may build a single, larger (the longer the better) version for demonstration. If students are able to make their own models, then it would create less traffic and crowding if all materials for students 1-4 are placed at different stations around the room. Then it will be easier for each group to pick up what they need and take it back to their own work area.

Begin by orienting the students to how the earth looks below the surface, demonstrating a working model and relating its parts to a diagram of the hydrogeologic cycle. Using unassembled materials, go over the basic assembly plan illustrated in Steps 1 - 9 on page two, briefly showing students how to put the model together. Then divide students into groups to build their own model.

STUDENT ACTIVITIES - MODEL ASSEMBLY:

For a group having four or five students, responsibilities may be divided among students as below.

Station/student 1 - Get two plexiglass panels (one with hole in it, as shown), duct tape, and a ruler and begin assembling model as show in steps 1 to 4 on page two.

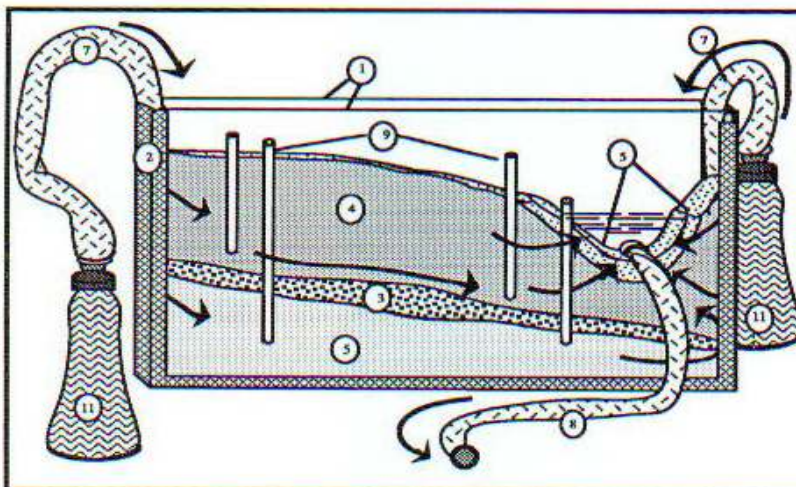
Station/student 2 - Collect plastic soap bottles, tubing ($1/2$ " I.D. and $1/2$ " O.D.), foam strips, and syringe or other aspirator. Force foam up about one inch into each of the large ($1/2$ " I.D.) pieces of tubing for use in step 5.

Station/student 3 - Collect sand, gravel, felt sheet and straws. Soak felt sheet in water, wring out, then roll the sheet into a tight coil about $3/4$ " thick and 20" long. Use in step 6.

Station/student 4 - First help student 1 with assembly steps 1 to 4, then get food coloring, water supply, cups.

Student 5 - Help with model assembly in steps 1 to 9.

Once the model is assembled, and water is flowing through the sand, into the river valley and out of the collector tube, do the activities on page two.



List of Materials (per model)

- 1 Two plexiglass panels - 10" x 20".
In one panel, drill a $3/8$ " hole located 5" from top and 5" from the edge.
- 2 Duct Tape - 2-1/2" wide roll
- 3 Lightweight felt-10" x 20" sheet rolled into tube
- 4 Sand - about 3 quarts
- 5 Pea gravel - about 2 quarts
- 6 Foam weatherstrip (Open-cell) $3/4$ " wide, with or without adhesive backing
- 7 Two 6" pcs. tubing - $1/2$ " inner diameter (I.D.)
- 8 One 6" pc. tubing - $1/2$ " outer diameter (O.D.)
- 9 Clear drinking straws or glass tubing
- 10 Ruler
- 11 Two dish soap bottles with bottom cut out.
- 12 Food coloring - at least three colors
- 13 Syringe or tap aspirator
- 14 Cups - 4 oz. paper and large (16oz) plastic



INVESTIGATIONS:

1. Which wells have the most water in them? Raise the water supply bottles as high as possible without pulling out the tubing – what happens to the water level in each of the wells and to the amount of water coming out of the collector tube? Next, lower bottles and observe what happens. How does the height of the water supply affect the water flow rate?

2. Pour out half of the water from the supply bottles, mark the water level, then pour a 4 ounce cupful of water into each bottle. Every few minutes, as the water reaches the mark, pour in another cupful of water. Also measure the total amount of water added during the time periods before the dye appears in water from the collector tub and after the dye is no longer visible in water from this tube.

3. At the same time, place 10-15 drops of food coloring on the sand at Point A shown in the assembly diagram for steps 7-9. On the plexiglass, mark the point with a water soluble marker. Every two minutes, make a mark on the plexiglass at the front edge of the dye as it moves through the sand. Measure the distance between the marks and record the distance moved per unit time.

4. Ask your teacher to show you how to do a 10-tube series of 1:2 dilutions of food color in water. Number each tube 1 to 10. Use this dilution series as a guide for

estimating the concentration of dye in the water coming out of the collector tub. After the dye you added in Step 3 above begins to appear in the water from the collection tube, collect a sample in a test tube every two minutes. Compare the color of this sample with each tube in the dilution series and record the number of the tube which is nearest in color to your sample. This will be a rough estimate of the amount of “pollution” in your sample.

5. Graph your data, plotting time on the x-axis and distance on the y-axis (Step 3). Also, plot time vs. concentration after dye appears in water coming out of the collector tube (Step 4). How long does it take for ground water to become clean again after being contaminated?

CLEANUP:

First, empty any water in the water supply bottles into the model and remove bottles and tubing. Then, place screen over a bucket and flush sand and gravel onto screen – use a screen with a mesh large enough to allow sand to sift through but small enough to catch the gravel. Rinse out foam strips and felt roll.

